CENTRAL INTELLIGENCE AGENCY **RESTRICTED**

INFORMATION REPORT

STAT

COUNTRY USSR

SUBJECT Building Construction

PLACE ACQUIRED

DATE ACQUIRED

DATE DISTR. 6 February 1948

NO. OF PAGES 7

NO. OF ENCLS. (LISTED BELOW)

STAT

SUPPLEMENT TO REPORT NO.

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE ACT 50 U. S. C., 31 AND 32, AS AMENDED. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW. REPRODUCTION OF THIS FORM IS PROHIBITED. HOWEVER INFORMATION CONTAINED IN BODY OF THIS FORM MAY BE UTILIZED AS DEEMED NECESSARY BY THE RECEIVING AGENCY.

THIS IS UNEVALUATED INFORMATION FOR THE RESEARCH USE OF TRAINED INTELLIGENCE ANALYSTS

STAT

FERROCONCRETE WORK IN THE CONSTRUCTION OF THERMOELECTRIC POWER PLANTS IN THE USSR

Engineers Romanov and Kiselev
Moskva

/Diagrams referred to herein are not reproduced./

Thermoelectric power plants represent a structural group composed of the most varied parts. This has resulted from combining into one operational unit extremely intricate objects which through their operational purposes are required to be entirely different from each other.

The following are among the most important structural parts of a heat power plant:

1. The main building which houses the boiler room, the machine room, and the water treatment section
2. Plant water-supply installations consisting of water intake and inlet and outlet canals. Dams and other hydrotechnical installations often have to be constructed in this connection.
3. Fuel installations consisting of fuel storage and transport equipment for fuel conveyance
4. Shaft installation
5. Converter station
6. Supply network, converter station (for changing voltage), and transformer houses
7. Auxiliary and administrative building
8. Dwelling houses and public buildings
9. Roads with bridges

The main building of the power plant is the most complicated and the most important installation.

A definite type can be established for the main building on the basis of many thermoelectric power plants under construction and expansion in the USSR as well as of many large power plants erected in foreign

CLASSIFICATION RESTRICTED

STATE	X	NAVY	X	NSRB		DISTRIBUTION
ARMY	X	AIR	X			

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130012-4

STAT

countries.

The most wide-spread type is that which unites in one building the machine room, the pumps, the water-treatment section and the boiler room. There they are arranged parallel to each other along the length of the building.

The most important construction in the main building is carried out in either ferroconcrete or iron.

While the restricted use of iron construction in former years was to be explained exclusively by the general shortage of iron, this reason is at present losing ground and the choice of building materials for main construction is determined by economic considerations.

Comparative computations on the construction of the main building, using in the one case ferroconcrete and in the other iron, proved that iron can compete with ferroconcrete provided the cost of completed iron construction does not exceed 450 rubles per ton and the present cement prices are made the basis of the comparison.

Undoubtedly the importance of iron construction in erecting power plants will greatly increase in the near future. This is particularly true since iron offers certain advantages in this field of building. Nevertheless ferroconcrete is at present preferred in power-plant construction.

On the basis of domestic practice in the construction of power plants, it may be assumed that the main building must have a cubical content of 2 - 2.5 cubic meters for each kw of performance capacity and that 4 - 5 percent of the cubical content of the building is devoted to base construction.

The entire process of carrying out the ferroconcrete work is made difficult by the extremely small amount of internal construction in the building.

A number of circumstances must be pointed out without prejudice before examining the ferroconcrete processes and their technical organization as a factor of extreme importance. Only by considering these facts can a proper estimate of achieved results be made.

The power plants are scattered over the great expanse of the Union and are often erected in thinly populated regions since a fundamental principle of electrification is the utilization of less valuable, local fuel deposits.

Power plants are often even erected in regions which do not have the necessary rail lines and the resulting construction difficulties are as follows:

(1) Lack of building material at the building site,
(2) great shortage of trained labor particularly technical personnel,
(3) extreme difficulty in procuring mechanical equipment. This forces workmen to rely on their own skill and on simple manual labor of all kinds.

In addition, the electrification must be completed in the shortest possible time. This forces the work to proceed so rapidly that there is often insufficient time for preparation and organization measures.

Therefore, since the ferroconcrete work had to be carried out energetically and systematically, special measures for the technical execution of the work had to be taken as a basis during the construction and all local potentialities had to be utilized.

Although ferroconcrete work represents an organic whole, there are different phases of the work, as follows: (1) form, (2) reinforcement, and (3) concreting. Details are given below.

In view of the fact, mentioned above, that the main building has

STAT

little internal ferroconcrete construction, the extremely important role of reinforcement in ferroconcrete work can be inferred.

Thus, in the first place, wood consumption must be extensively curtailed. At the same time, the best method and convenience in working must be maintained. This involves the use of the form system, which is required for normal execution of all ferroconcrete work.

For this purpose, a special form process was worked out by the Trust for Power Plant Installation Construction. This is to be used in the construction of heat power plants and it makes possible a considerable decrease in wood consumption. Formerly, for example, the wood consumption in a superstructure-scaffold system amounted to 1.3 cubic meters per cubic meter of ferroconcrete. This process succeeded in reducing the amount of wood to 0.75 cubic meter.

This form process is used where enough time is available for the concrete to harden and the construction forms to be removed before beginning the concrete work on the turbine bases.

In cases where the concrete work on the turbine bases must be begun before the completion of the ferroconcrete work in the main building, other form processes are used whereby intermediate props are omitted in the support of the floor forms of the machine room.

A circular saw with mechanical drive is indispensable for mechanizing the form work. In other cases, a planing machine is used for planing off boards so that the concrete will have an even surface after the removal of the forms. This is to eliminate supplementary work which was often necessary.

Likewise, small iron rotary cranes made on the building site are used everywhere for hoisting material.

Individual sections of the forms are usually prepared at the building yards, and afterwards transported to their destination and set up.

Wood of an inferior grade is used in order to decrease the cost of the form work as much as possible. The same wood is used repeatedly and a system was introduced whereby the return of intact material is suitably rewarded.

There are three phases to the reinforcement work, preparation, carrying, and erecting. The erecting and part of the preparation is carried out by trained iron workers, while the rest of the work is done exclusively by unskilled labor.

The problem of mechanizing the reinforcement work is solved as follows. In accordance with the above-mentioned circumstances, workmen engaged in the power plant construction must take all possible measures to create mechanical equipment in each individual case with the means on hand.

Such equipment often turned out so well in practice that the procurement of special factory-made equipment in many instances became unnecessary. For example, almost any already discarded press with adequate compression power can be easily fixed to cut reinforcement iron. Only a cutting device in the form of two ground-steel plates need be inserted into such a press to make it usable for cutting reinforcement iron. (Diagram 2)

Improvised equipment is also used for bending iron.

Diagram 3 represents an example of bending equipment prepared and perfected at one of the building sites of the power plant installations.

The equipment was tried out in practice and proved to be completely reliable in its performance. It represented a 100-percent saving in time as compared with manual labor.

Before beginning the concrete work care must be taken that the required strength of the concrete is attained.

To achieve the required grade of concrete a definite ratio of all building materials that go into the concrete is to be established, and in addition all operational regulations for carrying out concrete work must be observed.

STAT

In view of the fact that thermoelectric power-plant sites are at a great distance from one another and are often located in scarsely settled regions, the decision as to how far local building materials are suitable for the concrete work must be left to the nearest testing station where the concrete tests will also be undertaken.

Before carrying out the ferroconcrete work the most favorable combination will be determined in accordance with standards set for the project.

The determination of the concrete composition as a rule takes place at all building sites according to the Abrams or Graf process and depends on suitable selection of the grain gradation of the aggregate and maintenance of the required water cement ratio.

For example, at the Nizhegorod power-plant building site a mixture ratio of 1 : 1 : 5 produced a concrete type with the strength of one with a ratio of 1 : 2 : 4, while at the Sterovka power-plant site the same concrete strength was attained with a mixture ratio of 1 : 3.3 : 2.5.

A constant check on the concrete mixture by the Abrams settling test is considered absolutely necessary because difficulties in maintaining a steady consistency of the concrete are often encountered in carrying out the ferroconcrete work. The authoritative "Instructions for Concrete Checking at Building Site Laboratories" written by Prof Belov, was published to regulate the question of the ferroconcrete quality.

The concreting process represents the final and perhaps the most important phase in the ferroconcrete work.

It must be estimated that about 10,000 cubic meters of concrete are worked in constructing a thermoelectric power plant during the chief building period, that is, in the course of 7 months.

Under ordinary circumstances when the first $2\frac{1}{2}$ - 3 months are spent on preparatory work, ground work, masonry, form work, and reinforcement work, and the last month is to be regarded as the time required for the hardening of the concrete, a period of 3 or at best $3\frac{1}{2}$ months is left for the concreting.

In general, it may be estimated that when a strenuous effort is made, the concreting takes 2 to $2\frac{1}{2}$ months, even if it is begun in part prior to the time indicated above. Therefore, an average of 150 cubic meters of concrete must be worked daily.

In addition to the periods in which the concreting is to be carried out, the following circumstances are also important for the extensive mechanization of all concreting processes in the construction of power plants: (1) far-reaching reduction in work costs, (2) improvement of concrete work, (3) guarantee of adequate pay for the worker, (4) lightening of his work.

The effort to increase the performance of the equipment and machines led, in many cases, to mechanization of the most varied types. For example, in addition to Ibag towers, the complete equipment of concrete factories was in use, perfected concrete mixers, gravel washers, stone crushing installations, excavators, conveying installations etc. There was also improvised equipment which was mechanized to a varing degree.

As a characteristic example of different methods of solving the question of the rationalization of the concrete work, we give the example of the technical organization of the concreting in the erection of the transformer station building for the Sterovka heat power plant. (Diagram 4)

The building had three parts:

1. The converter plant (for increasing voltage) to 30 kilowatts.

STAT

This has two stories. Dimensions: Height, 11.4 meters; length, 17 meters.

2. Control station with two staircases and a gallery passage connecting it with the machine room. The five-storied part of the building was 19 meters high, 27 meters long, and 20 meters wide.

3. The converter station (for increasing voltage) up to 115 kilowatts has two stories and is 15 meters high, 60 meters long, and 20 meters wide.

Since the erection of this building was extremely urgent, it was planned as a ferroconcrete skeleton structure with masonry of a ferroconcrete hollow-wall type, that is, it looked as if it were a single unit of cast concrete.

The construction of the building required 3797 cubic meters of concrete.

While the main building was under construction, a special bridge with a narrow-gauge track (Diagram 5) was built above it in the lengthwise direction since the building was 100 meters long. This was to facilitate the form work by making possible transport of concrete to all parts of the building.

Two shaft hoists were used for the concreting. The very simple wood construction on the shaft hoists could be carried out on the spot by the ordinary carpenters at the building site (Diagram 6)

Two buckets on a common, motor-driven cable go alternately up and down the hoist shafts. While one bucket reaches the unloading place and dumps the concrete into a bunker attached to the shaft, the other bucket reaches the bottom of the shaft and is filled with the prepared mixture.

When the bucket reaches the top, it lifts the shaft gate to the height required for the automatic dumping of the concrete. As the bucket descends, the gate is automatically lowered and closes the shaft opening to prevent accidents.

The hoisting bucket is made of wood braced on the inside with sheet iron. Instead of a back and lower side it has a sloping wall.

The unloading bunker is provided with sheet-iron distribution pipes from which the concrete either goes to the funnels of the jointed distribution troughs or it is dumped into trucks. From these, the concrete likewise goes into distribution funnels which are arranged in a row along the conveying bridge.

The distribution pipes transport the concrete without interruption, dumping it alternately into the trucks and the distribution funnels. Movement in the latter is regulated by traps.

Organization of concrete preparation merits particular attention.

The gravel to be prepared by the crushing installation was loaded onto platforms by means of a caterpillar excavator from the "Ruston" firm. The use of this loading device was justified in that the cost of loading one cubic meter by manual labor amounted to 55 kopeks, while the cost by excavator was only 17 kopeks, provided that at least five freight cars could be loaded in 24 hours. In the present instance the daily (24-hour) turnover went as high as 156 cubic meters. The loading capacity of the excavator is three times greater than that of manual labor.

The gravel brought up on the standard-gauge track was unloaded directly onto the wooden conveying bridge, the floor of which is on the same level as the platform. The gravel was loaded on trucks from the other side of the conveying bridge. It was dumped directly through a closable opening in the wall of the conveying bridge.

The sand was brought up on the same track but from the other side.

The truck construction is extremely simple -- two compartments resting on a wooden frame with the wheel axle fastened to the under side. The

STAT

compartment bottoms are worked from below by hinges, and the content of the truck is dumped into two bunker compartments which are both on one truck.

A "Smith" concrete mixer with an hourly capacity of 6 - 8 cubic meters of concrete and another "Storer" concrete mixer with a capacity of 4 - 6 cubic meters are set up under the earth's surface. Each of them has a loading bucket which is arranged under the indicated bunker with four [sic] compartments so that the ingredients for the concrete go directly from the bunker into the mixer.

The bunker has a ceiling that is connected with the cement shed. Tracks are also laid along this shed. Over the bunker there are two measuring bunkers to move cement to the concrete mixer. The outlet apertures are provided with tubes to prevent the formation of cement dust and the consequent loss.

The water is furnished from a tank with gauges with automatic control which regulates the proportion of water.

The described installation has proved to be very successful because of the low cost, the possibility of utilizing it under any circumstances, and the great working convenience.

In the present case the cast concrete was not conveyed by troughs but by jointed chutes (Diagram 7). This had the following operational advantages:

1. Relatively high performance capacity of a concrete worker who worked 5 - 6 cubic meters of concrete in eight working hours.

2. It was possible to undertake concreting on the entire front and also to accelerate the work at any other working location.

3. The use of intermediate distribution funnels completely prevented disintegration of the concrete. This means definite improvement in the quality of the concrete in cast-concrete concreting.

Experiments on test cubes (20 cubic meters) after a 1½-month hardening period showed an ultimate strength of 172 - 266 kilograms per square centimeter when ordinary cement was used (96 percent of all ferroconcrete work), and an ultimate strength of 280 - 403 kilograms per square centimeter when tamponage cement is used.

The fact that the workers were adequately paid for careful work on the concreting also contributed to the success of this working process.

We cite the construction of a base for a turbogenerator with a performance capacity of 2,200 kilowatts as another characteristic example in the construction of heat power plants.

This base was constructed in the same year and by the same construction organization as the converter station already described.

The bases for turbogenerators (Diagram 8) with a capacity of 10,000 kilowatts and above are classed as important constructions. The technical specifications for carrying out the concrete work prescribe the use of a good concrete with increased strength and organization of the work in such a manner that the concreting may proceed without interruption so that the concreting joints will not open up as a result of the turbine vibrations.

On the basis of experiments, a concrete composition in the ratio of 1 : 3.3 : 2.5 was used, although Dr. Keler, the building consultant engineer, recommended one in the ratio of 1 : 2 : 3. The former type was approved by the Gruen & Bilfinger Corporation of Berlin. This was the firm which supervised the construction.

One concrete mixer was used in the operations. The other was kept as a reserve in case the main mixer or the hoist should be forced to stop operating and thus cause an interruption to the work.

STAT

The system used required jointed chutes with small funnels for the preliminary concrete mixture (before the concreting). This system succeeded in completely preventing concrete disintegration.

The concreting for the bases was completed in five days. 1028 cubic meters of concrete were worked.

The work of preparing the concrete was carried out by a group of 25 workers: one worker for the concrete composition; two for loading the concrete into the mixer, to load from the mixer into the travelling buckets of the hoist, and into trucks from the traveling buckets when they have reached the top; two workers to take care of the funnels; and 20 workers to transport the building materials (with ten trucks).

Only one concrete mixer, the "Smith" system with a capacity of 6 - 8 cubic meters was operating while a "Storer" system with an hourly capacity of 4 - 6 cubic meters stood by as a reserve. Accordingly, it is possible to estimate the extent to which present mechanization is utilized and to state, for example, that 1,000 cubic meters of concrete were processed in the course of 130 hours.

The fracture resistance of the concrete for the bases was 1 ton. The result of experiments on test cubes after a 1½-month hardening period showed an average of 132 kilograms per square centimeter.

Instead of passing judgment on the organization of the concrete work, we cite an excerpt from a letter addressed to the chief engineer of the building site. This letter was writtn by Engineer Nagel, who, as the representative of the Gruen & Bilfinger firm, checked the concrete for the construction of the bases.

"The division of work was efficiently carried out. This made it possible to achieve rationalization of the work in a minimum working period. Work was done at the rate of 5.05 working hours per cubic meter of concrete."

- END -